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CHEMISTRY.—*Five hundred meetings of the Chemical Society of Washington.*[1] FRANK C. KRACEK, Geophysical Laboratory, Carnegie Institution.

As Dr. Browne has clearly brought out in his two papers in this issue of the JOURNAL, the Chemical Society of Washington was founded by men who believed in the liberty of opinion and action of the individual. Several of them had been influential in the original organization of the American Chemical Society in 1876 in New York, but they later broke away, feeling out of sympathy with the spirit and procedures of that Society, which at that time was in effect a purely local group of chemists confined to New York City and its environs.

On January 31, 1884 these men held a formal meeting at which a constitution was adopted, and officers elected to serve during the ensuing year. The officers elected were: Thomas Antisell, President; Wm. Mew and F. W. Clarke, Vice-Presidents; H. W. Wiley, Secretary; W. H. Seaman, Treasurer; E. T. Fristoe, Thos. M. Chatard, J. H. Kidder and A. C. Peale, Members of the Executive Committee. The object of the Society "shall be the cultivation of chemical science, pure and applied." The membership of the Society consisted of 33, of whom 3 were connected with educational institutions, 7 were of private status, and the rest were in the service of the Government. As was to be expected, the early meetings were devoted to papers dealing with the professional activities of the members. No presidential address was delivered at the end of the first year; however, at the end of the second year, F. W. Clarke, the second president, delivered an address on the "Relation of the Government to Chemistry," and the custom thus started has been continued to the present day.

On December 10, 1893, at its seventieth meeting, the Society became affiliated with the re-organized American Chemical Society,

[1] This and the following two papers are published in commemoration of the 500th meeting of the Chemical Society of Washington, held on April 14, 1938. Received March 29, 1938.

as its "Local Section." It retained the management of its internal affairs and its name, although in the records of the national society it appears to be referred to as the "Washington Section." The events leading up to this step are recorded in detail by Dr. Browne. However, as part of the record, it is worth repeating here that F. W. Clarke and H. W. Wiley were primarily responsible in the re-organization of the American Chemical Society, and hence, the affiliation of the Chemical Society of Washington with the latter organization was a logical part of their larger plan.

To facilitate the administration of its affairs the Society was incorporated in the District of Columbia on March 25, 1926, formal action of the Society having been taken at its 376th meeting held at the Cosmos Club on March 11, 1926.

An event of great importance to the Society took place in the fall of 1924, when the executive committee first discussed the question of offering a prize for a "worthy contribution" by a member of the Society. The idea was adopted on an annual basis at the February 1925 meeting of the Executive Committee, and was made a permanent institution of the Society on February 9, 1928, at the 398th meeting. On June 6, 1933, the income from One Thousand Dollars was set aside to finance the Prize. This became known as the Hillebrand Prize Award, named in honor of W. F. Hillebrand, for many years an outstanding member of the Society.[2] The prize has unquestionably stimulated interest in the more outstanding contributions to chemistry by members of the Society, and has served to emphasize the fact that important advances in the science are being made within the Society in spite of the somewhat circumscribed sphere of research peculiar to the professional connections of the great majority of the members.

In its early days the Society published a "Bulletin" of which 9 volumes were published covering the years 1884–1895. Publication was resumed again in 1919, but lapsed after that year. In 1898 the Joint Commission of Scientific Societies of Washington was re-organized as the Washington Academy of Sciences. The Chemical Society, a member of the Joint Commission from its inception, became one of the seven founder societies of the Academy. When the Academy established its JOURNAL in 1911, the Chemical Society published its Proceedings in the JOURNAL up to and including the 300th meeting.

[2] The list of awards given to 1937 will be found in the "Proceedings," J. Wash. Acad. 28, 131 (1938). The award for 1937 was to Sterling B. Hendricks on the "Relation of Crystal Optics to Crystal Structure" and on the "Determination of Molecular Structures by X-Ray and Electron Diffraction."

Recently publication was resumed beginning with the 494th meeting.

In the preceding 54 years of its existence the Society has held 496 meetings, an average of 9.2 per year. There are 8 regular meetings per year, the odd figure above being accounted for by special meetings. Until quite recently the regular meetings were devoted to communications by members of the Society, outside speakers being heard at special meetings. In the more recent years this custom has

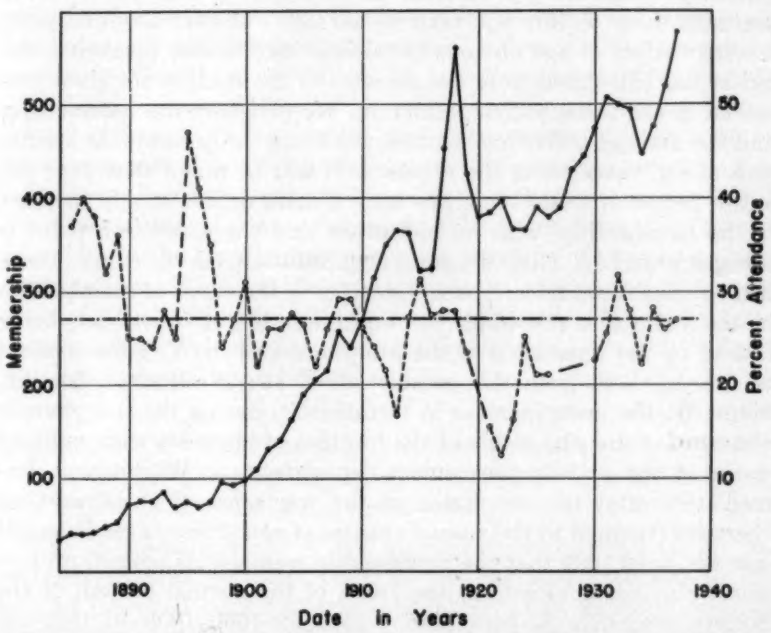

Fig. 1.—Chart of membership and percentage attendance of the Chemical Society of Washington from 1884 to 1937. Filled circles denote membership, open circles, percentage attendance. The horizontal dot and dash line represents average attendance for 54 years.

been losing ground, somewhat to the detriment of the members being afforded opportunities to present their original results before the Society. This, however, has been partially compensated for by holding one or two divisional meetings each year, with usually 9 or more papers being read by members in different sections. This procedure affords the Society an opportunity to listen to outstanding chemists from elsewhere in the United States and from abroad at many of its regular meetings. An expression of opinion from the membership

would be valuable in this connection. At present the responsibility for the type of meetings held rests with the Committee on Communications who can not be expected to be clairvoyant, but who make every effort to arrange programs that will be of interest to a large proportion of the membership.

The question arises whether the attendance is influenced by factors other than the obvious ones, such as the weather conditions and the type of program being presented. Proceeding on the assumption that precisely these factors will tend to average out over any one year, leaving factors of less obvious but deeper significance operative, the writer has calculated from the minutes of the Society the data presented in the accompanying diagram. We plot here the membership and the average percentage attendance along the ordinate, as a function of the years along the abscissa. It will be noted that over the entire period of years there has been a more or less steady increase in the membership, with no indication that the saturation point is being approached. There are some significant dips in the curve. These will be considered later. The irregularity in the curve of membership in the years just preceding the world war is not functional, being caused by the separation of the Maryland and the Virginia sections of the A. C. S. from the jurisdiction of the Washington Section. Similarly, the great increase in membership during the war years is abnormal, being the result of the location of chemists with military duties in the various government departments in Washington. Immediately after the conclusion of the war most of these wartime chemists returned to their usual spheres of activities; nevertheless, it was not until 1920 that the membership resumed its normal proportions. Significant arrests in the trend of the normal growth of the Society occur over the periods 1894–96, 1899–1900, 1908–10, 1922–25, 1925–27 and 1933–35.

The average percentage attendance over the 54 years is 27.1. The yearly average curve shows wide fluctuations. The years before 1890 were abnormal in the sense that the early enthusiasm connected with the founding of the Society had not had time to subside. From 1890 to 1894 attendance was normal, but in 1895 to 1897 attendance rose to the record proportions 41 percent over the three years, never even approached at any time since. It is significant that this did not occur immediately after affiliation with the national society. Subsequent to this period, there are attendance peaks at 1900, 1904, 1908–09, 1915, 1924 and 1932. The troughs are at 1898, 1901, 1906, 1913, 1922 and 1934. The data for the years 1927 to 1930 are in-

sufficient in detail, unfortunately, to be recorded other than a bare estimate. There is an interesting lag between the periods of economic depression and the peaks and the valleys in the attendance curve. Of particular interest are: the trough of subnormal attendance covering the period of the golden twenties, and the recent limited but sharp recession in 1934. In both cases, both the membership and attendance appear to have decreased and advanced simultaneously. The question of what happened to the government chemist during these two periods can be posed, to be answered by a competent sociologist. On the other hand, there is another question which the chemists can best answer themselves: Are the chemists only 27.1 percent alive, and if so, why?

This brief review of the activities of the Society must not be allowed to end without some mention of the commendable attitude adopted by it on questions involving the relation of chemistry and public welfare. Whenever such questions have arisen, from the early days when a sanitary water supply in most of our cities was a thing of the future, to as late as the present year, when the question of advocating adequate safeguards against the indiscriminate sale of possibly dangerous drugs, such as the "elixir of sulphanilamide" arose, the Society has always upheld the interests of the public. It is to be hoped that this will always be so in the future.

CHEMISTRY.—*Dr. Thomas Antisell and his associates in the founding of the Chemical Society of Washington.*[1] C. A. BROWNE, Bureau of Chemistry and Soils.

The Chemical Society of Washington owes its existence to the marked stimulus that was given to the chemical activities of the various Governmental Departments in the early eighteen eighties. The Government began to employ chemists a half century before this date but for the most part they were non-residents of Washington. Benjamin Silliman, Sr., Professor of Chemistry at Yale University, for example, was authorized by the Treasury Department in 1832 to make a chemical study of the cane sugar industry of the United States and his report on this subject, published in Washington in 1833, was the first chemical publication to be financed by the United States. With the coming of Prof. A. D. Bache to Washington in 1844, as Superintendent of Weights and Measures in the Coast Survey Office, another chemical research was assigned to Richard S.

[1] Delivered before the Chemical Society of Washington on April 14, 1938. Received March 29, 1938.

McCulloh, formerly professor of chemistry in Jefferson College, Penn., and later melter and refiner in the United States Mint in Philadelphia. His four reports on "Sugar and Hydrometers" were published in 1848 under the authorization of the Treasury Department as a Senate Document of 653 pages. It is a classic work which even now can be consulted with profit.

With the rapid growth of the work of the Patent Office, which was established in Washington in 1836, the services of resident chemists became necessary in order to examine the increasing number of patent claims relating to chemical subjects. One of these early chemical employees of the Patent Office was Dr. Thomas Antisell.

Dr. Antisell, like another famous American physician and chemist, Dr. William Macneven, was a native of Ireland. He was born of French Huguenot ancestry in Dublin on January 16, 1817, and was educated at Trinity College of that city. He then studied at the Dublin School of Medicine and the Irish Apothecary's Hall where he obtained his first chemical instruction under the well-known chemist, Sir Robert Kane. Antisell's medical education was completed at the Royal College of Surgeons in London from which he obtained his medical degree in November 1839. After a semester in the chemical laboratory of Pelouze in Paris he became assistant to his former teacher Kane with whom he remained three years. In 1844 he continued his chemical studies on the continent under such eminent teachers as Pelouze, Biot, Dumas and Berzelius. He then began the practice of medicine in Dublin, but, becoming involved in the political activities of the "Young Ireland Party," was sentenced to exile and imprisonment. He avoided this penalty, however, by escaping to America as surgeon on an outgoing vessel. His career as traveling student, doctor, chemist, Irish political agitator, exile to America and patriotic citizen of the United States tallied exactly with that of his fellow countryman Macneven of a generation before.

When Antisell sailed from Ireland in 1848, this young physician of 31 left behind him a considerable record of accomplishment in several branches of science. He had very early taken a deep interest in agriculture and in 1845 published a "Manual of Agricultural Chemistry with its Application to the Soils of Ireland." This was followed in 1847 by his "Outlines of Irish Geology" and his "Sanitary improvement of the City of Dublin."

Antisell landed in New York on November 22, 1848, and practiced medicine in that city for the next six years with occasional intermis-

sions when he lectured on chemistry at the Berkshire Medical Institution in Pittsfield, Mass., and at the Medical College of Woodstock, Vt. He became quickly identified with the civic affairs of his new home and during the twenty-second annual fair of American Institutes at Castle Garden in October 1849 delivered a series of addresses on "The Philosophy of Manufactures." He compiled also in 1852 a "Cyclopedia of the Useful Arts," a convenient 690-page illustrated handbook of progress and invention in different branches of applied science. It was a work requiring wide knowledge and great labor.

Wanderlust was a malady from which Antisell always suffered and in 1854 he dropped his medical practice to become geologist under Lieut. J. G. Parke in command of the Pacific Railroad survey. Antisell's geological reconnaisance of Southern California and the Arizona Territory was published in 1856 in volume seven of "United States Explorations and Surveys" of which a review is given in the 1904 Report of the Smithsonian Institution (pp. 453–5). After terminating this geological expedition Antisell came to Washington where on June 1, 1856, he was appointed first assistant examiner in the Patent Office. In connection with his duties as examiner he operated a small chemical laboratory in the basement of the old Patent Office building. The position, which paid a salary of $1,500, was apparently not wholly congenial to Antisell's versatile tastes as we may infer from the following letter which he wrote in 1857 to his friend, Dr. C. M. Wetherill:

"Washington
Patent Office
Nov. 15, 1857

My dear Wetherill:

"Let me refresh your memory by recalling your attention to my existence: which for the last few months has pursued the even tenor of its way without disturbance either by elevation or dismissal which has made moves abundant around me. I believe I told you in a former letter that I was an assistant Examiner here in the Chem. Department in the office: a place not very suitable to me but which has kept the wolf from the door until in Micawber phrase something better turns up. We have connected with this (Chemical) room a small laboratory where we can keep in our fingers in old ways—and it is in connection with it that I chiefly now write to you: Our gas arrangements for ignition purposes are very incomplete and Mr. Schaffer and self thought if we could get your apparatus as described in the *Franklin Journal* it would be a great matter to us and I have written to you to know could we order a Tilgenaus burner, & a Burner holder such as you have described with a Burner for distilling purposes or Sand bath as found on pp. 274, 275 & 276 of Vol. 28 of *F. Journal*, from any one in Philadelphia or could you recommend us to a man who would do them for us & to let us know what

sum probable would cover the expense of same: we have to get a sum allowed by the Commissioner for that purpose. Could you also tell us the cost of a Duffys Balance for coarse purposes—to weigh from 1 lb. downwards to a dram. We have already two fine balances but not one coarse one.

"Situated as we are in a city where nothing out of the common run is to be had we have to depend on our friends for assistance. You will therefore excuse this trouble, & if I can be of any use to you here call upon me. May I enquire after your wife and ask whether she is a disciple of Malthus or not?

Believe me
Sincerely yours,
Thomas Antisell

C. M. Wetherill, M.D.,
or &c.
Philadelphia."

We know from this letter of Antisell and from other contemporary notices that there was not at this time a well equipped chemical laboratory in the whole city of Washington.

Between the years 1842 and 1862 the Patent Office in addition to its regular activities discharged the agricultural functions of the Government, and Antisell, in the midst of his other duties, devoted a part of his time to the chemical examination of soils and other agricultural products. His opinions on agricultural chemical research are well expressed in an address which he gave before the U. S. Agricultural Society in 1858 "On the Application of Chemical Science to Agriculture" from which the following quotations are made:

"Occupied as the writer has been since 1840, with analyses of soils, the value of which was then brought prominently forward by Liebig, and having made from that period to the present time nearly 2,000 analyses (certainly above 1,800) of various soils, both of this country and of Europe, he is glad on the present occasion, after an experience of nearly 20 years, to state his conviction of the value of the present relation of chemistry to agriculture.

"In 1840, an ardent believer in the value of analyses of soils, every year's experience has tended to shake his conviction in its utility as carried on, and confirmed him in the belief, that it was both incomplete in its object, and deceptive in its result. That ardent belief has merged into sober caution, and has ended in positive distrust, that a mere chemical analysis of the soil can be of any, even the smallest use to the farmer, for he has come to understand that the constitution of a soil is not that simple matter formerly believed: so complex is it, that no analytic formula properly expresses it, and as usually performed, the analysis is of no value, either to science or to practice" (pp. 1–2).

"Manuring is still too much carried on as if it were to benefit the soil—instead of the plant—and the farmer enriches his soil with elements in manure, which he does not know whether his crop requires at all, or requires at the time when it is added" (p. 2).

"The question then arises: Do we know sufficient of the mineral constitution of plants, so as to state what that constitution precisely is in each

species? We must in truth say we do not fully know the exact mineral formula of any plant: and yet as far as we do know, it would seem that a species differs somewhat from every other species, in either the quality or the quantity of its ash.

"If we do not know these constituents of a plant, how can we safely recommend special manures? Thus, the practice and the prosperity of the art of agriculture depends so far on the knowledge which chemistry has yet to impart to the farmer" (pp. 2–3).

"There is as much difference between the flour of Massachusetts and Alabama as between the wheat flour of Scotland and Egypt. This is attributed to climate, but what does climate effect? How is it that climate produces more gluten? Does it also increase the phosphates? Or, can the phosphates applied in liberal amount, replace the influence of climate? In other words, can the use of special manures in the northern states replace the latitudinal effects and solar influences of the south? Chemical analysis, as conducted at present, gives us no data from which any conclusion on so important a subject could be drawn" (p. 8).

"The majority of analyses found in our text books are derived, as stated, either from soils or plants of European countries, and as the ash bears a certain relation to the soil, that relation is lost for want of reference to the soils of this country. The knowledge of the constituents of the ash of a crop is but a portion of the knowledge derivable therefrom, when unaccompanied by the constitution of the soil" (p. 8).

"We want experiments which shall go to determine what are the mineral elements of a plant which are found in connexion with and which go to build up the various food and respiration elements in the plant. What salts assist in putting up gluten; what aid in sugar, starch, &c.? Or, stating the question in general terms, what are the mutual relations between the organic and the inorganic parts of plants?

"It is too much to ask the agriculturist in the field, or the chemist in the laboratory, to devote, unaided, both time and skill to elucidate this complex problem, involving a large number of experiments of growth and of chemical analysis. This would be the experiments suitable for a State agricultural farm and a State chemist. The function of the latter officer should not be confined to making analyses of soils or testing manures, to be conducted at cheaper rates than private men of science can perform such analyses for, and which only result in the benefit of a few individuals, and are of no benefit beyond that of the moment. But the business of a State chemist should be that of elucidating and philosophizing upon the various circumstances which combine to augment the growth and the produce of our food plants. The office of State or model farms should be, by well devised experiments upon the growth of plants, to raise agriculture from its present position of an *empirical art*, to the condition of a *science*" (p. 9).

"It is believed that a portion of the grant so generously bestowed by the federal government, for the benefit of agriculture, could not be better employed than by devoting some portion of it for this end" (p. 9).

All this is the soundest kind of agricultural chemical doctrine. The passages quoted illustrate the clarity of Antisell's views with regard to the true field of agricultural chemistry—views that might well be adopted as a statement of purpose at the present time.

Antisell, whether working as chemist or geologist or patent exam-

iner, could never forget that he was first of all a physician and very soon after his arrival in Washington he began lecturing to the medical students of Georgetown College on chemistry, toxicology and physiology of which subjects he was for many years a professor. On several occasions he gave valedictory addresses to the graduating medical students of Georgetown who were so impressed by their excellence that they printed them each year in small pamphlet form as tributes of affection to their teacher. As an additional evidence of Antisell's industry and versatility it should be mentioned that he published in 1859 a book on the "Manufacture of Photogenic and Hydrocarbon Oils from Coal."

The outbreak of the Civil War had a very depressing effect on chemical research in the United States from which it did not fully recover for twenty years. The activities of chemists, both North and South, were diverted to military purposes. Antisell, although promoted on May 3, 1861, to the position of principal examiner in the Patent Office, resigned on September 30th of this year to devote all his energies as physician and surgeon to the care of sick and wounded soldiers. He entered the army as brigade surgeon of volunteers, with the rank of major. Dr. W. H. Seaman, President of the Chemical Society of Washington in 1894, has left this record of Dr. Antisell's military service:[2]

"He served first with Banks' division and the Fifth army corps, then became successively medical director of the Department of the Shenandoah, Second corps, Army of Virginia, and Twelfth army corps; in October, 1862, was in Harewood hospital, Washington, D. C., and in 1863 president of a medical examining board, and post surgeon to August, 1865. He was brevetted lieutenant colonel, United States volunteers, March 13, and honorably mustered out of service October 7, 1865. In the service he was noted for his reckless disregard of personal danger for himself or his assistant surgeons when the wounded required attention in the rear of the line of battle, and probably saved the life of many a poor fellow by the prompt and skillful aid he rendered."

In connection with his military duties as medical officer, Antisell presented several reports in 1864 to the Medical Society of the District on the sanitary condition of Washington.

It is somewhat remarkable that the Department of Agriculture should have had its birth in 1862 during the turmoil of a bitter war. The first scientist appointed to this new organization was Dr. Antisell's friend, Dr. Charles M. Wetherill, a distinguished chemist, who had studied under Liebig at Giessen, and was eminently qualified to

[2] Bul. of the Philosophical Society of Washington, Vol. 13, p. 368, 1895–1899.

fill the position of Department Chemist. He equipped a laboratory in the basement of the old Patent Office building but had scarcely entered upon his new duties when he was detailed by President Lincoln to make experiments for the War Department on a new type of ammunition. The furlough was longer than at first intended and when Wetherill returned to his old post he was curtly informed by Commissioner Newton that his salary with the Department of Agriculture had ceased with his detail to the War Department and that his services were no longer needed. President Lincoln tried to intercede for Wetherill but Newton was stubborn and Wetherill to avoid the stigma of a dishonorable dismissal appealed to Congress. Congress completely exonerated Wetherill and, as a rebuke to Newton, directed the Secretary of the Treasury to pay Wetherill "the sum of seven hundred and fifty dollars in full for his services as chemist of the Agricultural Department." The case aroused much indignation in scientific circles. Wetherill's unhappy experience was typical of many other later cases where Government scientists have been made the victims of autocratic injustice.

Wetherill was succeeded as Chemist of the Department of Agriculture by Dr. Henry Erni, later one of the founders of the Chemical Society of Washington, who after two years of faithful service resigned his position. Dr. Antisell, who had just been mustered out of military service, was then appointed by Commissioner Newton to the office of Department Chemist and, more fortunate than his predecessors, remained for five years in this position for which he was splendidly qualified by past training and experience. He was a skilled analyst; well versed in geology, medicine, botany and physiology; and the author of numerous books and articles relating to agricultural subjects.

If sufficient time were available I could speak to you at some length about Dr. Antisell's work as Department Chemist. I have brought with me one of his laboratory notebooks, written in beautiful script, with a full record of his analytical reports between January 2, 1868, and his resignation on June 30, 1871. In this three and one-half year period there was an interruption between July and November 1868 when the Department moved its quarters from the Patent Office to the new brick building on the Mall. In conformity with custom the laboratory in the new building as in the old was consigned to the basement and there it remained for over twenty years. A long hard battle with ancient prejudice had to be won before chemists were permitted to ascend from darkness to higher levels.

Antisell describes in this notebook the analysis of 189 samples of which only 117 can be called agricultural. Sixty samples or about one-third of the total number were minerals, such as pyrites, ores of metals, etc., sent in for the most part by Congressmen to satisfy the curiosity of over-credulous constituents. For many years Government chemists had their time frittered away with such trivialities, "to the detriment of science and the benefit of nobody," as Dr. Clarke, one of our early presidents, once caustically remarked. Antisell called attention to this evil in his first report for 1866 in which he made the following very pertinent suggestion:

> "The propriety of any department of the government authorizing work to be done for the benefit of private enterprise is questionable, and as there are at all times abundant sources of employment for chemical science in connection with agriculture . . . the work in the laboratory should be confined within its proper sphere of limitation."

This is sound doctrine but several decades had to elapse before the principle here announced was put into effect.

Of the agricultural samples in this notebook that were analyzed by Antisell, 26 were marls, 24 soils, 16 fertilizers, 12 wines and musts, 12 waters, 5 tanning materials, 5 medicinal plants and a long list consisting of sugar beets, fruits, Indian plants, sugars, peat and other miscellaneous products. Antisell did also much service work for other departments, such as investigations of cancelling inks for the Post Office and of building stone for the Treasury Department.

In May 1869 Antisell wrote a long interesting report to Commissioner Capron on the fertilizing value of the mud from the bottom of the old canal which once transported produce from the Potomac along what is now Constitution Avenue to the city market. This canal received much sewage and its muddy deposits were supposed by many to have great fertilizing value. Antisell showed that the wet mud, at the very highest estimate for its content of lime, phosphoric acid, potash, ammonia and other ingredients, had a manurial value of only 98 cents per ton which would not pay the farmer for hauling it away. Antisell condemned the canal as a menace to the health of the city because of its highly offensive emanations, which he regarded, in accordance with the old theory of miasms, as "potent causes of disease."

Antisell's reports as Department Chemist are included in the annual reports of the Commissioner of Agriculture for the years 1866 to 1870 inclusive. In the 1866 report he published a special article on "Cultivation of the Cinchona in the United States" which contains

suggestions that were afterwards tried but have not been realized largely because of economic reasons. Antisell's 1867 report is a chemical plea for the establishment of a domestic beet sugar industry. His arguments were sound and undoubtedly had an influence in after years in promoting this enterprise. Antisell was mistaken, however, in his view that the culture of the sugar cane in the south was soon destined to disappear.

In addition to his chemical duties at the Department of Agriculture Antisell continued his practice of giving lectures before the medical students of Georgetown College which signified its appreciation of his learning by conferring upon him the honorary degree of Doctor of Philosophy. In 1869–70 he also taught chemistry at the Maryland Agricultural College.

Commissioner Newton died in 1867 and was succeeded by General Horace Capron under whom Antisell served during the whole period of his office. In 1871 Capron resigned to accept a call by the Japanese Government to head a commission for improving agricultural conditions in that nation and Antisell accompanied him on this expedition as technologist. He was decorated by the Emperor of Japan with the Order of the Rising Sun and received other honors in recognition of his services. The climate of Japan, however, was injurious to the health of Mrs. Antisell, so he returned after six years to Washington where on May 10, 1877, he was reappointed to the place in the Patent Office that he had resigned in 1861. He remained in this position until ill health obliged him to retire in 1891. In his last years of sickness he was tenderly cared for by his daughters. He died on June 14, 1893, in his seventy-seventh year and was buried in the Congressional Cemetery.

It will be seen from this brief sketch that Dr. Antisell was a man of deep learning, wide experience and great industry. According to his friend, Dr. Seaman, who was associated with him for many years in the Patent Office, Antisell in official life "had the reputation of being reserved and even somewhat brusque, but among his friends he was cordial and even warmhearted, with an abundant supply of the wit and humor for which the Irish race has been always noted."

Chemists, who in point of numbers now excel the other scientists of Washington, were few and far between in the decade following the Civil War. Dr. F. W. Clarke, in his presidential address before our local Society in 1885, relates that when he first came to Washington in 1873, chemistry had gained but a precarious foothold. In the various Governmental institutions there were probably at that time not

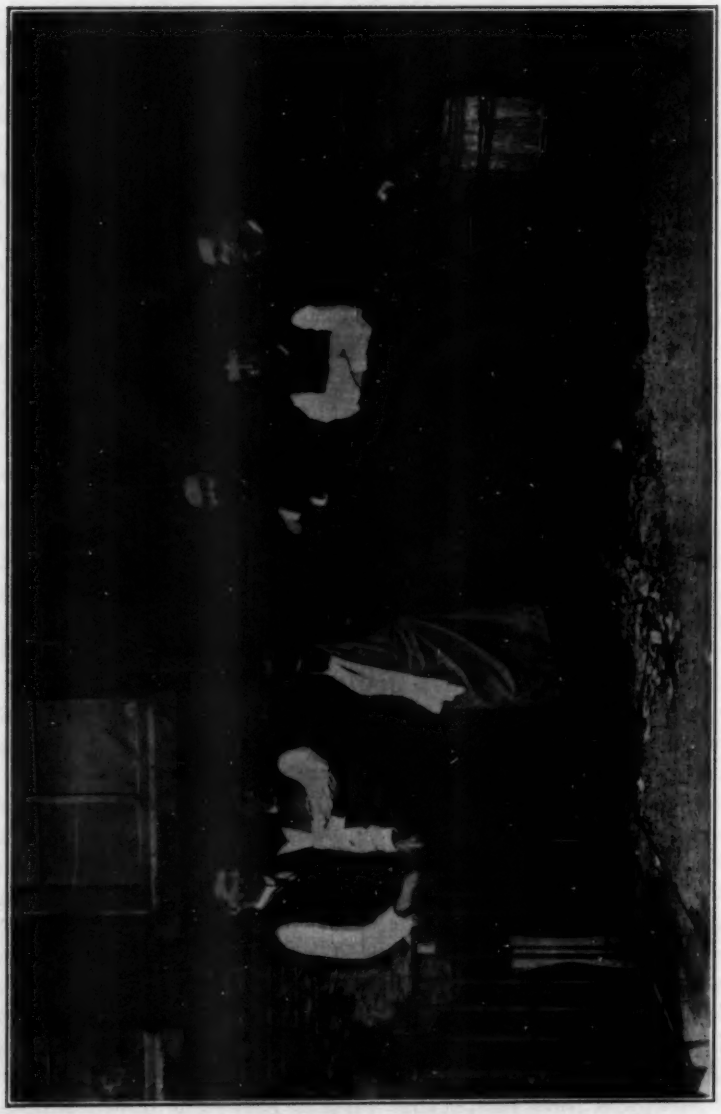

Fig. 1.—Personnel of the Divison of Chemistry of the United States Department of Agriculture in the year 1885. Left to right: E. Richards (on lower level), A. E. Knorr, John Dugan, C. A. Crampton, H. W. Wiley, T. C. Trescot, Miles Fuller.

a dozen men who could qualify to the title of chemist. But about the time of Dr. Antisell's return to Washington, in the late seventies there was a marked increase in the chemical activities of the various Federal departments.

There were probably at least fifty chemists who could have qualified as foundation members of the Chemical Society of Washington. The need of an organization had been felt for several years but nothing was done until January 12, 1884, when a meeting was called in the office of Dr. Wm. Mew in the Army Medical Museum and the following resolution was adopted:

"*Resolved*, That it is desirable to organize a Chemical Society in the District of Columbia; said Society to have for its object the cultivation of chemical science, pure and applied."

A committee was appointed to arrange the time and place of an organization meeting, to notify interested chemists and to draw up a constitution.

At the organization meeting which took place on January 31, 1884, thirty-three chemists of the District took part. Of these founders of our local Society, 6 belonged to the Patent Office, 5 to the Department of Agriculture, 4 to the Geological Survey, and 4 to the National Museum. The Treasury Department, Columbian University, Howard University, the Smithsonian Institution, Bureau of Education, City High School, Museum of Hygiene and Army Medical Museum were represented with one member each. There were also six founders of a private status. Other chemists were admitted at subsequent dates until at the 32nd meeting of the Society, which took place on April 12, 1888, just 50 years ago last Tuesday night, there was a membership of 45 resident and 10 non-resident chemists.

It was most fitting when the Chemical Society of Washington was organized that Dr. Antisell should have been elected its first president. He does not seem, however, to have taken an active part in the Society's meetings. He presented no papers and there is no record of his having given a presidential address. The foundation members of our local Society were mostly young men in their early thirties and Dr. Antisell, as a staid veteran of 67, may have felt somewhat abashed in the presence of such a group of exuberant youngsters. As an old time chemist of the eighteen thirties and forties he was perhaps also a little unsympathetic with the new movements in chemistry when atomic weights and formulas were being drastically revised. I remember how my father, a self-taught chemist, was shocked when I came home one day in 1889 from college and told him that the formula for water was not HO, as he had led me to believe, but H_2O.

Professor E. T. Fristoe, who preceded Dr. Charles E. Munroe as Professor of Chemistry at Columbian University, and was president of our local society in 1887, was proud of asserting that he was one of the earliest American chemists to adopt the new reforms by which the formula of water and the atomic weight of oxygen were changed. Dr. Wiley, who preceded Fristoe as president, tried to humble his pride, however, by proving from holy scripture that the formula HO was correct. He quoted from the beginning of the 55th Chapter of Isaiah, "HO, everyone that thirsteth, come ye to the waters," in which not only the formula but the name and use of the aqueous fluid are mentioned. This was said "off the record" for no mention of it is found in the minutes or discussions of the Society.

Next to Antisell, Professor Fristoe was one of the oldest chemists among the founders of our Society. He was born in Rappahannock County, Va., in 1827 and was educated at the Virginia Military Institute and the University of Virginia from which he received the A.M. degree in 1855. In 1862 he entered the Confederate Army where he served with distinction as colonel of cavalry until the close of the war. In 1865 he was elected to the chair of chemistry in the Columbian College in Washington and in 1871 was appointed professor of chemistry in the Medical Department of Columbian University—a position which he held until his death in 1892.

Fristoe taught chemistry in the old Columbian University laboratory on the site of the present Woodward Building, in the auditorium of which the early presidents of our local Society gave their annual addresses. Several of Fristoe's pupils (among whom are K. P. McElroy, E. G. Runyan and Geo. Steiger of Washington, and H. O. Chute of New York) tell interesting stories of his methods of instruction. Fristoe was progressive not only in adopting the new chemical notation but in emphasizing the importance of chemistry in the college curriculum. In his presidential address on "Chemistry as Factor in Education" he announced that we "live, move, and have our being by the grace of Chemistry" and advocated, on practical, cultural, and even religious grounds, that the old trivium of Latin, Greek and mathematics should give way to the newer claims of chemistry.

H. W. Wiley of the Department of Agriculture and F. W. Clarke of the Geological Survey were the chief moving spirits and most active members of our early organization. In the first five years of its history Wiley presented twelve papers and Clarke nine. W. H. Seaman of the Patent Office followed a close third with eight papers. All of these men were presidents, Clarke succeeding Antisell in 1885, Wiley

succeeding Clarke in 1886 and Seaman coming later in 1894. Clarke's presidential address on "The Relations of the Government to Chemistry" contains an eloquent plea for the consolidation of the Government's scattered chemical activities into a single well-equipped and thoroughly organized National Laboratory whose chemists should be free from political interference or caprice and independent of fear or favor. Wiley was also at this time a great believer in a centralized national Laboratory but the rapid growth of specialization in the scientific work of the different Departments prevented the realization of this ambitious scheme.

Wiley's presidential address on "Our Sugar Supply" related to a subject in which at that time he was very actively interested, as he had experiments under way upon the production of sugar from the sugar cane, the sugar beet and the sorghum in different states of the country. In this era of Governmental regional laboratories it is well to remember that Wiley was the first to inaugurate technological field investigations of this kind. His address is typically Wileyesque. He quotes apt phrases from the Latin, Greek and German and refers to his much censured sugar undertakings by remarking:

> "On this billowy sea, and amid these dangerous rocks, like a saccharine Ulysses, with taffy-occluded ears, I have tried to steer the frail bark of scientific investigation."

Clarke and Wiley were great wits and the hilarity which they imparted to the early meetings of our local Society had a contagious quality. Like Kidder, Chatard, Richardson, Munroe, Diller and several other Washington chemists of a half century ago they were Harvard graduates and, like members of a well trained crew, these men always pulled together. The effective work of Clarke and Wiley in completely reorganizing the American Chemical Society was told in my address of four years ago.

Next to Clarke and Wiley the most influential member among the founders of our local chemical society was William Henry Seaman. For many years he was professor of chemistry at Howard University and an examiner in the Patent Office. He was a member of the committee for revising the U. S. Pharmacopaeia of 1880–90 and was an active participant in the work of many local scientific societies. His papers before this organization cover a wide class of subjects ranging from models of molecular structure to the Sloper gas machine.

Seaman was a great stickler on the proper spelling of chemical terms. According to Patent Attorney K. P. McElroy "Doctor Seaman was the chemist who took the ph out of sulphur and induced the

American Chemical Society to like it that way." The spelling of sulfur and all its derivatives with an f is a thorn in the flesh of the Government Printing Office as it is to all our British chemical friends. I have always wondered who the miscreant was that first put the ph in sulfur where it had no business, either scientific or etymological, of belonging. Hats off to Doctor Seaman who made us move in the right direction.

Another picturesque figure in the Patent Office group of founders, to which Antisell and Seaman belonged, was Dr. D. B. Kelley. He was an Irishman and has been described as a rather portly man with florid countenance, very loquacious and somewhat of an epicure in his choice of foods. His fondness for mushrooms nearly cost him his life as it did that of his friend, the Italian Count Achilles de Vecchi. They mistook the poisonous fly amanita toad-stool for the edible kind: de Vecchi died but Kelley was saved by the liberal use of atropine. In the delirium produced by the poisonous mushroom alkaloid muscarine Kelley thought he had actually died and gone to heaven but St. Peter sent him back with the remark that his time had not yet come. This was a famous case and an account of it by Kelley and his attendant physician was given before our Washington Chemical Society in the late eighteen nineties.

A somewhat similar alkaloidal story concerns another founder—Dr. William M. Mew of the Army Medical Museum in whose office the preliminary organization meeting of the Washington Chemical Society was held. Mew who was an Englishman was exceedingly fond of smoking and found that he could immunize himself against the effects of overindulgence in the weed by taking strychnine. On one of these occasions he took an overdose of strychnine. He felt coming on the characteristic constriction of the facial muscles produced by this alkaloid and then rapidly reasoned that if strychnine is an antidote for nicotine then conversely nicotine should be an antidote for strychnine. He therefore began puffing a strong cigar and forthwith the effects of the strychnine passed away. A deduction of this kind, which reminds one of a back titration in volumetric analysis, could have been conceived only by a person with strong chemical imagination. Mew was greatly interested in the chemistry of alkaloids and in the old laboratory notebook of the Department of Agriculture's chemical division, which I have brought with me, is a letter of his to Dr. William McMurtrie, chemist of the Department from 1872 to 1877, wherein he describes a method for determining morphine.

The fifth president of the Chemical Society of Washington was Dr.

Jerome Henry Kidder of the Smithsonian Institution. He was born in Baltimore and graduated from Harvard in the class of 1862. He served as Medical Cadet in the Union Army during the Civil War and obtained his medical degree from the University of Maryland in 1866. Like Antisell and other founders of our Society he was interested in many branches of science. He wrote on big game shooting in Alaska and prepared two articles on the natural history of Kerguelen Island in connection with the American Transit-of-Venus expedition of 1874–5 of which he was a member. He served for many years as a surgeon in the U. S. Navy but resigned in 1884 to accept an appointment as chemist to the Fish Commission. He was a very active member of our early Society and his papers related to such subjects as the nesslerizing of air washings, the Bower-Barff rustless iron process and the gilding of glass. His presidential address in February 1889 upon Air was illustrated by many photo-micrographs of suspended air impurities such as dust, pollen, spores, bacteria and crystals. Kidder died from pneumonia two months after the delivery of this address and his passing was lamented by a host of friends.

The sixth president of the Society, Edgar Richards, and the seventh president, Dr. Charles A. Crampton, were members of the Chemical Division of the Department of Agriculture. Richards was a native of New York City and a graduate of the Columbia School of Mines. He was assistant chemist of the Department of Agriculture from 1882 to 1887 and chemist of the Bureau of Internal Revenue in the Treasury Department from 1887 to 1892 when he returned to New York to practice as a consultant. His papers before our early Chemical Society related to milk analysis, oleomargarine and methylated alcohol. His presidential address in 1890 on "Some Food Substitutes and Adulterants" is a reflex of the campaign which Dr. Wiley and his staff were then conducting against deceptions in the sale of food.

Dr. Crampton, whom many of this audience remember, followed Richards from the Department of Agriculture to the Treasury Department and was chief of its Division of Chemistry from 1893 until his death in 1915. His early papers before the Society were partly collaborative with Dr. Wiley and T. C. Trescot and related to such food products as starch, sugar, malt liquors and fats and oils. Crampton's presidential address, on "Food Preservation and Food Preservatives" in January 1891, covered a subject that provoked immense agitation fifteen years later when Dr. Wiley began to enforce his new Pure Food Law. Crampton in his address took the position long held

Fig. 2.—Chemists and Physicists of the United States Geological Survey in the year 1887. Seated, left to right: J. E. Whitfield, F. A. Gooch, C. Barus (physicist), R. B. Riggs. Standing, left to right: F. W. Clarke, W. F. Hillebrand, T. M. Chatard, W. Hallock (physicist).

by Wiley that "the world and its food supply would be better off today if the use of antiseptics as food preservatives had never been discovered."

Crampton, Wiley and other early colleagues of this Society should be remembered also for their having founded and laid out with streets and trees the present suburb of Somerset, which was started primarily as a place of residence for Government chemists. It was there that Crampton erected a beautiful home and even now several of our members reside in this pleasant community.

It would be a serious omission in discussing the early founders of our Society if I failed to refer in this anniversary lecture to its ninth president, Dr. Thomas M. Chatard. He was born at Baltimore, graduated from Harvard in 1871 in the same class with his life long friend, Dr. Charles E. Munroe, and obtained his Ph. D. degree from Heidelberg in 1876. Chatard then served as assistant chemist in the Torpedo Corps of the U. S. Navy from 1870 to 1872 and as instructor in Chemistry at Pennsylvania from 1872 to 1874. After working as mine and mill manager from 1877 to 1883 he served as chemist of the U. S. Geological Survey from 1883 to 1892 when he resigned to take up the practice of consulting chemist. In 1900 he became a special agent of the Census Bureau. The report of Munroe and Chatard upon "Chemicals" in Volume X, Part 4, of the Twelfth Census (pp. 525–679) is a classic and will long be referred to. Chatard's papers before our early Society relate to silicate analysis, the manufacture of salt and western alkali deposits. His presidential address in January 1893 on "The Abuse of Explosives with Suggestions for Preventive Laws" deals with a subject of perennial importance and can still be read with profit.

A half century ago there was a group of younger assistant chemists in Washington who made their first attempts in authorship at the early meetings of our Society. Reference will be made to only two of these—Dr. Guilford L. Spencer, a foundation member, and Augustus E. Knorr who joined the Society at its third meeting. Spencer followed Dr. Wiley from Purdue to Washington in 1883 and for the next twenty years, as assistant chemist and Chief of the Sugar Laboratory of the Bureau of Chemistry, conducted field experiments in sugar technology that were of world wide importance. He designed the sucrose pipette and many other time-saving pieces of apparatus and was the author of a Handbook for Cane Sugar Manufactures that is still the leading work of its kind. Spencer spent the last twenty years of his life as supervisor of sugar manufacture for several large

estates in Cuba. It was in discharging the duties of this position that he died suddenly in harness on March 23, 1925. His papers before the early Society relate to the estimation of phosphoric acid, the extraction of sugar from molasses, the fibre of Louisiana sugar cane and the estimation of theine in tea.

Augustus Knorr, who was a member of the Chemical Division of the Department of Agriculture from 1884 to 1892, was an interesting combination of the chemist and glass blower. He designed many novel pieces of apparatus which were much used in their day. His papers before the early Society describe various pieces of laboratory equipment which he devised such as a gas regulator and an extraction apparatus without corks or stopper. The latter utensil, known as Knorr's extractor, was described with other pieces of his apparatus in the Proceedings of the Association of Official Agricultural Chemists for 1890.

At the fourth meeting of our Society on April 24, 1884, two chemists joined who afterwards won great distinction as non-resident members in their respective fields. These were Dr. William Frear, then assistant chemist in the Department of Agriculture, and later Professor of Agricultural Chemistry at the Pennsylvania State College, and Dr. Frank Gooch, then chemist of the U. S. Geological Survey and afterwards Professor of Inorganic and Analytical Chemistry at Yale. Frear became known for his work on food standards while Gooch is best remembered for his invention of the crucible that bears his name. Frear presented a paper at our ninth meeting on the determination of gluten and Gooch read a paper at our tenth meeting on filtration by means of easily soluble and easily volatile filters. Frear and Gooch remained on our roster as non-resident members many years after their retirement from Washington.

There were also among our early members several scientists who could hardly be classified as chemists. Among these was Dr. W J McGee best known for his work in geology, archeology, ethnology and anthropology. He prided himself upon being a member of all the scientific societies of Washington and it was probably for this reason, and not for any particular love of chemistry, that he joined our Society at its fifteenth meeting. McGee was wrong, however, in stating that he was a member of all the scientific societies of Washington. There was one organization to which his entrance was eternally barred; it was "The Women's Anthropological Society." McGee was generally known by his nickname "No Stop" for the reason that he permitted no periods to be inserted after the letters W J, which he

insisted were not initials but his actual name. Wherever the name W J McGee was signed, or attached, or indexed you will find no stop or period to interfere with its continuity. It is rumored, however, that his full name was actually William John McGee.

The Chemical Society of Washington at its foundation meeting had an enrollment of 33 members. This number had increased at the end of the year to 40. In the following years there was an average annual increase of about 8 members, including non-residents, until by the year 1893, at the time of the amalgamation with the American Chemical Society, the membership of the Local Society reached a total of 97, of whom 70 were resident and 27 non-resident. In this period of independent existence the Society held about seven meetings a year, the number of papers presented at each meeting varying from 0 to 5. With its small membership, of whom only about one third were contributors of papers, it was not always easy to arrange a program and hurry calls were often sent out a few days before a meeting for a scratch contribution. But after all one main object of a scientific meeting, then as now, was to bring the men together for personal contacts. We often derive more benefit from the random exchange of ideas in the interlude of a meeting, or at a society dinner, than from the papers of a prearranged program.

The attendance at the early meetings of our Society was small. The average of those present including guests during the first five years of its history was only eighteen. It fell at some meetings as low as nine and was never more than twenty-five. These numbers were vastly exceeded, however, at the annual meetings when the President gave his retiring address. On these occasions which were first held in December and after 1888 in January or February, members of the Philosophical Society, Anthropological Society, Biological Society, Entomological Society, Microscopical Society and the Cosmos Club with ladies and guests were invited to be present and the capacity of the hall was then sometimes filled to overflowing. The monthly gatherings of the early Society were usually held in what is now the east end of the main reception room of the Cosmos Club, this meeting place being separated from the rest of the room by a folding door. For the larger annual meetings the entire reception room was sometimes thrown open, but the capacity of this was too small to seat the combined membership of all the scientific bodies of Washington and their guests. When a very large attendance was expected the meetings were usually held in the auditorium of Columbian University.

The records of the early meetings of our Society with its programs, results of elections, resolutions, reports of committees, presidential addresses, constitution, by-laws, lists of members, etc., were published as an annual bulletin. This appeared for nine years until May 1895 when further issues were suspended. It is greatly to be regretted that this publication came to an end. A continuous run of these bulletins for 54 years would have now a decided historic value. The discontinuance of the bulletin was of course a result of the amalgamation of our early organization with the American Chemical Society. The Journal of the latter took the place of the bulletin. It is one of the costs of any kind of consolidation that the individual surrenders a part of his identity and this inevitable loss is proportionate to the magnitude of the unification. This law applies not only to scientific societies but to trusts, to Government bureaus and to totalitarian states. After a lapse of twenty-four years the reconstituted Chemical Society of Washington recognized this loss and attempted in February 1919 to recover a part of its lost identity by bringing out a new issue of its old bulletin but somehow the heart of the membership was not in it and the revived publication soon perished from lack of support.

This closes my attempt to picture for you a few of the individualities, the scientific attainments, the witticisms, the eccentricities, and the foibles of some of the early founders of the Chemical Society of Washington. Lack of time has prevented me from including something about Dewey, Diller, Hitchcock, Israel, Kalusowski, Lawver, Littlewood, MacLean, Merrill, Packard, Peale, Read, Robinson, Taylor, White and Yeates, all worthy members about whom much could be said. In this group of men were representatives from England, Scotland, Ireland, the Continent of Europe and from many states of the Union;—men who had fought on opposite sides in the Civil War but who now united were all anxious to do their part in the upbuilding of a restored nation.

Our early organization was a small Society but what was lacking in numbers was made up in enthusiasm and good fellowship. It was a collection of the choicest spirits. The great Harvard trio, Frank Clarke, Harvey Wiley and Charles Munroe, was alone sufficient to keep any society agoing. Only a few of our founders are now left but those disconsolate words "*Pulvis et Umbra*" are not to be inscribed upon their monuments. The inspiration of their personalities and the influence of their work will always continue.

CHEMISTRY.—*The Chemical Society of Washington and its part in the reorganization of the American Chemical Society.*[1] C. A. BROWNE, Bureau of Chemistry and Soils.

The year 1934, which is the semi-centennial of the founding of the Chemical Society of Washington, is distinguished for a large number of chemical anniversaries. It is also the semi-centennial of the founding of the Association of Official Agricultural Chemists. It is the hundredth anniversary of the birth of Mendeleeff, Schorlemmer and Sprengel among European chemists and of G. C. Caldwell, a former President of the American Chemical Society, among American Chemists. It is also the hundredth anniversary of the publication of Prout's "Bridgewater Treatise on Chemistry" a famous work which exercised a great influence at the time both upon chemical and religious thought. This year is also the two hundredth anniversary of the birth of the famous English chemist, Thomas Henry, and of the death of Stahl, the founder of the doctrine of Phlogiston.

But it is not about these men that I have been requested to speak this evening but about a few of the founders of the Chemical Society of Washington and their relations to some of the chemical developments in the United States of a half century ago. The decade between 1880 and 1890 in which this chemical society came into existence was one of the several transition periods that seem to appear in the history of American chemistry at approximately 50-year intervals. There was a similar transition period in the decade between 1830 and 1840 and we are passing through another of these very disquieting epochs in the present decade of 1930 and 1940. These periods of readjustment come inevitably after a time of severe business depression when the stability of industries and institutions is threatened. They are usually the aftermath of some great war, such as the War of 1812, or the Civil War, or the recent World War.

The changes that took place in the transition period of 1880–1890 were manifested not only in industry but were evident also in the fields of education and scientific organizations. The attempt to merge the loosely organized local lyceums and other scientific organizations of fifty years ago into large national groups of chemists, biologists, engineers, etc. was rendered extremely difficult by a spirit of strong individualism and independent freedom of action. The leading founders of the local Chemical Society of Washington—men such as Clarke and Wiley, to name only two of those whom I knew so long personally

[1] Read before the Washington Chemical Society, April 26, 1934. Received March 29, 1938.

—were strong individualists. They belonged to the old school which believed in liberty of opinion and action, and their strong spirit of individualism gave these men a rugged picturesque type of personality that is lacking in the present generation. The clash between these opposing tendencies of individual and unified action can be exemplified in no better way than by observing what took place in the early history of the American Chemical Society and the Chemical Society of Washington. The details of this movement, which were narrated to me by various members of the opposing factions who have now nearly all passed away, are not generally known and they deserve to be recorded as an interesting phase in the annals of American Chemistry.

The American Chemical Society, as at present constituted, is the composite result of various streams of influence acting from both within and without over a long period of time. Indeed, the consecutive steps in organizing a national society of chemists in the United States might almost be called an experimental method of trial and rejection and many years had to elapse before events could finally develop into the type of organization with which we are now familiar. American chemists seem to have been interested more at first in the establishment of journals than in the organization of a society. The Journal of Applied Chemistry, the Boston Journal of Chemistry and The American Chemist all began publication before the first movement was made to organize a national chemical society.

The first steps towards effecting a national organization of American chemists were taken on August 25, 1873, at the meeting of the American Association for the Advancement of Science in Portland, Maine, when a subsection upon chemistry was formed. Of the chemists present on that occasion it may be noted that seven of them—G. F. Barker, F. W. Clarke, T. S. Hunt, S. W. Johnson, William McMurtrie, C. E. Munroe and H. W. Wiley—afterwards became presidents of the American Chemical Society. The formation of this chemical subsection of the American Association is important because of the influence which it afterwards had upon the organization of a national chemical society. Of the charter members of this subsection (which became Section C in 1882) it is interesting to note that four of them—Clarke, Munroe, Warder and Wiley—were afterwards presidents of the Chemical Society of Washington.

The next important event that led to the formation of a national chemical society occurred on July 31 and August 1, 1874, when a group of some seventy leading American chemists met at the old

home of Dr. Joseph Priestley in Northumberland, Pennsylvania, to celebrate the one hundredth anniversary of Priestley's discovery of oxygen. Every chemist who attended that meeting felt the stimulating influence of his contact with colleagues from all parts of the country and the wish was generally expressed that the members there gathered might form the nucleus of a national society of chemists. A plan for such an organization was soon formulated and after much preliminary discussion the American Chemical Society was founded on the evening of April 6, 1876, in the Lecture Room of the College of Pharmacy in the old building of New York University on Washington Square of New York City. The new Society started out under favorable auspices and soon could count in its membership many of the leading chemists of the United States.

Unfortunately the Directors of the American Chemical Society at the time of its inception made the fatal mistake of attempting to centralize everything locally within New York City where the majority of its members were living. There was then among this New York group a certain obstinate clique, wholly unsympathetic with American traditions, which for a long time blocked every effort to make the Chemical Society a truly representative national organization. The result was that, almost as soon as formed, the Society began to disintegrate into its original units. On January 4, 1877, F. W. Clarke submitted his resignation within two months after his election. Clarke's resignation was followed by those of G. F. Barker, William McMurtrie, W. F. Hillebrand, Edgar Smith, H. W. Wiley and Ira Remsen. In other words, within five years after the Society's organization seven of its future presidents, four of them Washingtonians withdrew from the membership. In this group of malcontents who either resigned or were suspended for the nonpayment of dues must also be counted Edward Hart, who was editor of the Journal of the American Chemical Society from 1893 to 1901, S. P. Sadtler, W. D. Mason and numerous other chemists of national prominence. Evidently things were not going well in this first effort to establish a national chemical society.

The primary cause of the spirit of disunion which threatened the existence of our chemical society in the first decade of its existence was the fact that its board of directors were all residents of New York, that its monthly meetings were all held in New York and that chemists who lived at great distances from this metropolis were unable to take part in the Society's activities. Chemists outside of New York, therefore, looked upon the Society as a purely local organization and

were unable to see that conditions for them were any better than before its foundation. In order to dispell the belief that the Society was only a local affair, the policy was adopted of selecting its presidents from chemists who lived outside of the Metropolitan area. This palliative measure, however, was wholly ineffective in promoting an increase in the members of the Society. The total membership of the American Chemical Society in 1881 was only 243, of whom 119 resided in the Metropolitan district of New York and 124 in the regions beyond. Six of the latter lived here in the City of Washington, of whom four, E. T. Fristoe, B. S. Hedrick, W. P. Lawver and W. M. Mew, were among the founders of the Chemical Society of Washington.

Another cause of discontent was the very meager size of the Journal of the Society. As compared with its predecessor, "The American Chemist," which it superseded, the new Journal was an inferior publication as regards both quality and quantity of contributions.

It seems to us at the present time rather strange that the New York City group of chemists did not recognize sooner the futility of attempting to conduct a national society upon the basis of the status quo as it existed in 1880 and that they did not come sooner to the correct solution of the problem of securing cohesion between widely scattered independent groups of chemists within a national organization. The local independent group development, already existent in the old lyceums, took a more definite form with the foundation of the Cincinnati Chemical Society in the early eighties and of the Chemical Society of Washington on January 31, 1884.

The moving spirits in the organization of this local Washington Society were F. W. Clarke, H. W. Wiley and other malcontents who had seceded from the American Chemical Society with headquarters in New York City. Twenty-seven chemists belonging to different Government and local organizations, and six chemists of private status constituted the charter members of the Washington Society. This was a good representation of the various local organizations at a time when chemistry was just beginning to play a part in Government Research.

It is interesting now to inquire as to the effect of the organization of the Chemical Society of Washington upon the American Chemical Society. One result was a gradual transfer of the allegiance of the local chemists who were still members of the American Chemical Society to the new Washington Society. The policy of these men at first seems to have been one of watchful waiting. At the end of 1886, three years after the founding of the Chemical Society of Washington, only

two of the local group of four who at first belonged to both societies continued as members of the American Chemical Society, Dr. Hedrick having died and Dr. Mew having resigned. Dr. Friscoe and Dr. Lawver dropped out in 1887 and for the next three years the American Chemical Society was without a member in the City of Washington.

Meantime the membership of the American Chemical Society, so-called, had been steadily declining. The enrollment of 243 members in 1881 had declined to 167 in 1889 of whom only 76 lived beyond the New York district. The Journal of the Society appeared at only irregular intervals and for the year 1889 numbered only 158 pages.

At this time when the affairs of the American Chemical Society were at their lowest ebb, Dr. F. W. Clarke of the Chemical Society of Washington and also a most active member of Section C of the American Association for the Advancement of Science, was taking active steps towards organizing a National or Continental Chemical Society. A committee of Section C was appointed with Clarke as Chairman to confer with various chemical societies upon the best plan of accomplishing such an organization. In this work Clarke was ably supported by Dr. H. W. Wiley who at the Sixth annual Convention of the Association of Official Agricultural Chemists in Washington on September 11, 1889, strongly recommended the organization of a national chemical society. Wiley mentioned that this plan had aroused some opposition, one objection being the existence of a society which claimed to be the American Chemical Society. He had once been a member of that society but the only benefit which he received from the connection was a receipt for his annual dues. He had, therefore, after paying his dues, resigned. It was now time, Wiley stated, for the chemists of the country to form a national association strictly and purely American in its character. It was intended not to confine it to the United States but to include the chemists of Mexico and Canada and in fact the whole continent of North America.

Following Dr. Wiley's remarks at this meeting of the Association of Official Agricultural Chemists, Dr. Clarke made a statement which is interesting because it is one of the earliest forecasts of the type of organization which the American Chemical Society was soon destined to assume. As a result of Clarke's canvass of chemists, which he made as Chairman of the Committee of Section C of the American Association for the Advancement of Science, "the general consensus of opinion seemed to be that in order to avoid the danger of localizing the society it would be necessary to follow to some extent the example of

the Society of Chemical Industry in Great Britain, which has a number of sections in different parts of the Kingdom. There was a London section, a Liverpool section, sections at Manchester, Birmingham, Newcastle, Glasgow, and other points, the several sections all cooperating through one journal. Probably the same plan would be feasible in this country, where there were already a goodly number of centers of chemical industry."

In conformity with the plan thus outlined Clarke and Wiley issued in 1889 a circular letter to the chemists of America which had for its purpose: "To organize a Continental Chemical Society, representative of all North America, by affiliating together as far as possible existing local organizations. The society as a whole to hold an annual meeting at such time and place as may be agreed upon from year to year; while local sections, like the sections of the British Society for Chemical Industry, shall have their regular frequent gatherings in as many scientific centers as possible, all publishing their work in one official journal." (Proceedings, Amer. Assoc. Adv. Sci. 1890, p. 141–2.)

Obviously this movement of Clarke and Wiley to establish a chemical society that would be truly American could not be without some influence upon the officials of the American Chemical Society so-called. Certain of its own members had long foreseen the need of reform. Among these was Prof. C. E. Munroe, then of Newport, R. I., who, thoroughly aroused at the spirit of indifference which was hampering the initiation of necessary reforms within the society, attempted to bring about from the inside what Clarke and Wiley were endeavoring to accomplish from without. His views upon the holding of general meetings and the establishment of local sections were expressed in a letter which was read at a meeting of the American Chemical Society in New York on November 1, 1889. This letter seems to have been instrumental in securing action, for at the next meeting on December 6 plans of reorganization were fully discussed, in which connection President Chandler expressed the hope that this might be effected upon the plan of the Society of Chemical Industry. The good influence of these efforts was reflected in a very optimistic editorial in the first issue of the Journal for 1890 regarding the reorganization of the Society so as to make it truly national and also in an announcement upon the revision of the Society's Constitution in which suggestions were invited by the Committee from the different members. A revised constitution was thereupon prepared and adopted by a majority vote of the Society at its meeting in New York on June

6, 1890. The new constitution provided for the establishment of local sections of the Society but the New York group continued to assert its claim of leadership by maintaining that the headquarters of the Society should be the City of New York and that the annual meeting for the election of officers and committees should be held at the headquarters.

Another article of the new constitution was the provision for holding general meetings of the American Chemical Society in localities outside of New York. In view of the fact that this reform had been suggested by Prof. Munroe, the duty of demonstrating its success was now put squarely up to him and accordingly the Directors voted to hold the first general meeting of the Society at Munroe's home city of Newport on August 6 and 7, 1890, and nominated him the chairman of the local committee of arrangements. This meeting was a great success, there being present a representative gathering of forty chemists from different parts of the United States. On the second day of this meeting there was a general consideration of the question of organizing the chemists of America and Dr. Clarke opened the discussion by sketching a brief history of the new movement for a "Continental" society. As a result of this discussion a committee of the American Chemical Society was appointed to confer with representatives of other societies and organizations of chemists as to a plan of consolidation.

In reply to the arguments of Clarke and Wiley to establish an entirely new national chemical society, the representatives of the American Chemical Society urged in behalf of their own title to national standing that it had had a continued existence for fourteen years, that it published a journal and had built up a library. They showed also from the lists of its presidents that there had been no discrimination in favor of New York against chemists of other localities. In a subsequent report by F. W. Clarke, H. C. Bolton and Edward Hart for the Committee of Section C of the American Association upon a national chemical society (Proceedings, Indianapolis meeting, 1890, p. 139–140) it was said of the American Chemical Society: "It has surely been national in spirit though local by force of circumstances. Towards the movement which we have initiated it is in no wise hostile, and it seems quite clear that by means of mutual concessions of a wholly minor sort a union with it can be effected." This is the first indication of a possible healing of the breach which had so long existed between New York and Washington. A new spirit of conciliation seems to have prevailed as soon as the old American Chemical Society

manifested a willingness to meet with its critics and to consider their suggestions in the organization of a national chemical society.

At a second general meeting of the American Chemical Society, held in Philadelphia on the 30th and 31st of December 1890, at which seventy-five chemists were in attendance, the conference committees of the different chemical societies were announced who were to consider the plans for a national organization of chemists. These committees represented seven different organizations of chemists—the American Chemical Society, the Chemical Section of the American Association for the Advancement of Science with Dr. F. W. Clarke as Committee Chairman, the Association of Official Agricultural Chemists with Dr. H. W. Wiley as Committee Chairman, the Washington Chemical Society with Prof. W. H. Seaman as Committee Chairman, the Chemical Section of the Franklin Institute, the Chemical Section of the Brooklyn Institute and the Manufacturing Chemists' Association of the United States.

Meanwhile, without waiting for the completion of these plans for organizing a national society, the chemists of Rhode Island under the leadership of Professors C. E. Munroe and J. H. Appleton had resolved to form a local section of the American Chemical Society in accordance with Article X of the revised constitution adopted by the New York chemists. A petition was accordingly submitted to the directors of the Society (all thirteen of whom were New York chemists) on December 31, 1890, for the establishment of a Rhode Island Section of the American Chemical Society and this petition was granted on January 21, 1891. Thus was created the first local section of the American Chemical Society. The point of special significance in this connection is that the Rhode Island group, most of whom were then members of the American Chemical Society, chose to work out the problems of reorganization within the Society itself. Their petition, however, was a tacit recognition of a New York directorship in the management of the Society's affairs, which was the very thing that Washington secessionists under the leadership of Drs. Clarke and Wiley desired to abolish.

As a result of the invitation of Dr. Clarke the third general meeting of the American Chemical Society was held in Washington on August 17 and 18, 1891, in conjunction with the meeting of the American Association for the Advancement of Science. At this meeting members of conference committees of ten different chemical societies met on August 17 to draw up plans for a general organization of chemists. These societies in the order of membership were the American Chemi-

cal Society with 290 members, the Chemical Section of the American Association for the Advancement of Science with 200 members, the Association of Official Agricultural Chemists with 75 members, the Chemical Section of the Brooklyn Institute with 75 members, the Washington Chemical Society with 70 members, the Chemical Section of the Franklin Institute with 70 members, the Chemical Society of the University of Michigan with 60 members, the Louisiana Sugar Chemists' Association with 52 members, the Cincinnati Chemical Society with 29 members and the Manufacturing Chemists' Association of the United States of unknown membership. The committees of these different organizations, representing approximately 1000 American chemists, passed by unanimous vote the following resolution:

Resolved, That it is the opinion of this conference, 1st, That the American Chemical Society be so extended as to include the members of all local societies in its membership; 2nd, That the New York members of the American Chemical Society be requested to organize a local section of the American Chemical Society in New York.

This resolution was the determining factor which solved the preliminary difficulties of organizing a national chemical society in the United States. The New York group was placated by the retention of the old name, American Chemical Society, but was deprived of all claims of priority or leadership by being requested to reorganize upon the basis of a local section. Except in name the proposed reorganization was an entirely new chemical society.

The immediate result of this resolution was its acceptance by all the interested chemical organizations. As a first indication of the reestablishment of harmonious relations the two Washington leaders of the secession movement, F. W. Clarke and H. W. Wiley, were reelected members of the American Chemical Society on October 2, 1891. The hatchet was not altogether buried, however, for there were still certain objectionable features in the existing constitution and charter of the American Chemical Society that required correction before Clarke and Wiley would consent to bringing the chemists of the societies which they represented into the fold of the reorganized American Chemical Society. It should be noted, however, that with the resumption of their old membership in the American Chemical Society by Clarke and Wiley, the remaining reforms which they strove to accomplish were worked out within the Society itself.

The revised constitution, which the local American Chemical Society had accepted on June 6, 1890, had first to be revamped in order to meet the acceptance of the new National organization. At the

fourth general meeting of the Society held in New York on December 29 and 30, 1891, a committee was accordingly appointed on the revision of the constitution, the draft of which was presented by Dr. Wiley at the Fifth General Meeting which was held at Rochester on August 16 and 17, 1892. Dr. Wiley also moved at this meeting that a committee of three be appointed to amend the old charter of the American Chemical Society so as to remove the objectionable section requiring that a majority of the Board of Directors shall be residents of New York.

The revised constitution of the American Chemical Society, which was finally adopted, removed practically the last semblance of control of the Society's affairs by the old local group of New York chemists.

The final consummation of all the plans for the reorganization of the American Chemical Society was achieved with the election of Dr. Wiley as President at the Sixth General meeting in Pittsburgh on December 28 and 29, 1892, when an entirely new arrangement of affairs came into existence. A considerable amount of politics, of the old horse-trading type, characterized the election of Dr. Wiley at this critical juncture of the American Chemical Society's affairs. The New York chemists, realizing again the necessity of selecting a non-resident of their city as the next president, favored the nomination of a candidate from the newly established Rhode Island Section whose members although not wholly satisfied had remained loyal to the then existing organization. Professor Munroe and Professor Appleton were mentioned as candidates in this connection but it was soon realized that if the strong rebellious Washington faction was to be fully placated it would be the best policy to put in a Washingtonian as the next president. After considerable canvassing and maneuvering it was decided that the election of Dr. Wiley would probably help most towards welding the various local groups of American chemists into a unified national organization. Dr. Wiley was accordingly elected and the wisdom of his selection was shown both by the rapid increase in the membership of the American Chemical Society and by the great quickening of interest in chemistry in all parts of the country that took place during the two years of his administration.

The first important indication of these new developments was the transference of the entire membership of the Washington Chemical Society to the rolls of the American Chemical Society. The advisability of making this change in the status of the Chemical Society of Washington was debated among the individual members both with-

out and within the meetings of the Society. The topic of discussion at the sixty-third meeting of the Society on December 8, 1892, with President T. M. Chatard in the chair, was "National Chemical Society Plans." Some opposition was expressed at this meeting against the plan of incorporating the local Washington society as a section of the American Chemical Society. Professor Munroe, who had recently transferred his residence from Newport to Washington, spoke at this meeting upon the advantages of such an incorporation and because of the leading part which he played in the formation of the first local section of the American Chemical Society in Rhode Island early in the previous year, his remarks were no doubt instrumental in winning many adherents to the plan.

According to the abstracts of the Proceedings of the Chemical Society of Washington for its sixty-seventh meeting on April 13, 1893 with President Dewey in the chair (Bulletin of the Society, No. 9, p. 65), "the question of becoming a local section of the American Chemical Society was ordered to be submitted by the Secretary to the members of the Society individually, their action to be reported at the May meeting." This action, however, seems to have been only a delayed effort to secure official confirmation of an agreement which had been formed two months previously, for in the Minutes of the Council of the American Chemical Society for February 26, 1893 (Jour. Am. Chem. Soc. *15* (1893), p. 296) we read that a petition had already been submitted to the Board of Directors "to incorporate the Washington Chemical Society as a local section of the American Chemical Society" with the signatures of H. W. Wiley, E. A. de Schweinitz, F. W. Clarke, Geo. Steiger, Charles E. Munroe, W. M. Mew, Robt. B. Warder, Wm. H. Seaman, Jas. H. Griffin and Claude A. O. Rosell.

At this point an interesting complication arose for the petition requested the incorporation of the Washington Chemical Society as a local section of the American Chemical Society whereas the constitution of the latter did not provide for incorporating any other organization as a local section but merely for the formation of a local section "by the Board of Directors on the receipt of a written request to that effect, signed by ten members of the society and endorsed by a majority of the Council." The signers of the petition were accordingly requested to make out a new petition in conformity with the requirements of the constitution to the Board of Directors who thereupon issued to the ten signatories under date of May 10, 1893, a charter for the formation of a local section of the American Chemical Society

in the city of Washington. The members of the new Washington section for their own local purposes retained the name of their old organization, "The Chemical Society of Washington," but added thereto in parentheses from this time on (Local Section of the American Chemical Society).

Meanwhile, acting apparently individually but unquestionably in conformity with a concerted plan, fifty-seven members of the Chemical Society of Washington had already been duly elected members of the American Chemical Society on March 13, 1893 (Minutes of the Council, Jour. Am. Chem. Soc. *15* (1893), pp. 58–59) which it will be noted is two months earlier than the granting of the charter and also two months earlier than the official report of the secretary of the Chemical Society of Washington at its sixty-eighth meeting on May 11, 1893 (Bulletin 9, p. 66) that "sixty members of the Society had reported in favor of becoming a section of the American Chemical Society." The local society as an official body was evidently slow in keeping up with the activities of its own members.

The final act in this reorganization of the Chemical Society of Washington was the appointment by President Dewey at this same meeting of May 11, 1893, of a committee consisting of Messrs. Wiley, Chatard and Peale to revise its Constitution and By-Laws in accordance with the action of the Society. The Constitution, as revised by this Committee, was adopted on December 14, 1893.

The incorporation of the Chemical Society of Washington as a section of the American Chemical Society was a dramatic event for it marked definitely the healing of the old breach between New York and Washington which began with the resignation of F. W. Clarke from the American Chemical Society over sixteen years before.

Another important event during Dr. Wiley's presidency, coincident with the changes just mentioned, was the transfer in the management of the Society's Journal. Until 1893 the publication of the Journal of the American Chemical Society had remained entirely in the hands of a New York editorial committee whose chairman was the late Professor A. A. Breneman—an able man who for many years had rendered most faithful service in helping to keep the Society going until a national organization could be perfected. Under the new scheme of ruthlessly eliminating all New York affiliations the old editorial committee was now abolished and on April 12, 1893, Professor Edward Hart of Easton, Pa., was elected Editor, who, with Professor Edgar F. Smith of Pennsylvania and Professor J. H. Long of Chicago, constituted the new Committee on Papers and Publications.

As an ex-member and past chairman of the New York Section of the American Chemical Society I wish to commend the willing spirit of the fine old group of New York Chemists to submit without protest to these severe acts of discrimination. Many of these men were my closest friends and now that they have all gone to their final reward I wish to state that their feelings were decidedly hurt. They did not resign, however, but continued to show their loyalty to the reorganized Society by working always for its best interests. I have always felt that it would have been a kind and magnanimous act to have retained Professor Breneman, at least for a time, upon the editorial board of the reorganized Journal. Society politics of the period seems, however, to have dictated the slogan that no good could come out of Gotham.

Professor Hart, the new Editor of the Journal, was also the head of the Chemical Publishing Company and the owner of the Journal of Analytical and Applied Chemistry. Under the new arrangement Hart became not only the Editor but also the publisher of the Journal of the American Chemical Society. He agreed at the same time to suspend the publication of his own Journal with the issue for June, 1893 sending to his subscribers for the rest of the year the numbers of the Journal of the American Chemical Society. This act of consolidation proved to be very beneficial to the Society.

A third chief event of Dr. Wiley's presidency of the American Chemical Society was the International Congress on Chemistry held at the Columbian Exposition in Chicago August 21–26, 1893. Eighty-three members of the American Chemical Society attended this Congress of which Dr. Wiley was chairman of the Joint Committee.

In welcoming the members of the Congress, at which were many distinguished foreign chemists, Dr. Wiley thus referred to conditions existing in the United States:

"In this country our chemical workers have been widely scattered. Our friends from abroad must not, therefore, be surprised to find less *esprit du corps* among us than in their own countries. We have been whirled hither and thither in the wild molecular melange of a rapidly growing country. But now there are many centers of crystallization forming, and soon you will find among us more unity of action, more mutual helpfulness. One of the organizations which I have the good fortune to represent at this time is bringing into intimate relations large numbers of our American chemists and cementing them into a body which gives promise of lasting good in the future. Already more than half a thousand American chemists have joined hands, and it is their united hand, big, brawny, and right honest in its grasp, which is extended to you today."

It is interesting also to record that at this meeting Dr. Wiley sug-

gested the establishment of a Triennial International Congress on Chemistry to meet in different countries. This recommendation led ultimately to the establishment of the International Congresses of Pure and Applied Chemistry which were held at triennial periods until the outbreak of the World War and are now being revived in 1934 with the present meeting in Madrid.

Dr. Wiley was reelected president of the American Chemical Society for the year 1894. As an evidence of the new vigor which was infused into the American Chemical Society during the two years of his presidency it should be noted that the membership of the organization more than doubled during this period having increased from 351 to 722 and that the size of the Journal also more than doubled having increased from 402 pages in 1892 to 891 pages in 1894. His administration may, therefore, be considered to mark the turning point in the affairs of the American Chemical Society and the beginning of its present phenomenal growth.

Such in brief is the story of the movement which led to the founding of the Chemical Society of Washington and to its subsequent incorporation as a section of the American Chemical Society.

The question might be asked in conclusion whether the problem of reorganization could not have been worked out more amicably within the Society according to the plans advocated and followed by Professor C. E. Munroe without the disagreeable secession movement which was initiated and fostered by Dr. Clarke. This is a hard question to answer but my opinion is that a secession of some kind was inevitable and necessary in order to enforce upon the minds of certain obstinate members of the old society the lesson that a national scientific society cannot be organized except upon a basis of the strictest local sectional equality.

It is to be hoped that the need for such a movement may never again arise in the history of our American Chemical Society. But if it should arise let us hope that the work of reform may be conducted as worthily and as effectively as it was carried out by two of the founders and early presidents of this Chemical Society of Washington—those doughty champions of the right of individual freedom of opinion and action—Frank W. Clarke and Harvey W. Wiley.

CHEMISTRY.—*Response to the award of the Hillebrand Prize for 1937.*[1] STERLING B. HENDRICKS, Bureau of Chemistry and Soils. (Communicated by FREDERICK D. ROSSINI.)

One appreciates the Hillebrand award not so much for the personal recognition as for recognition of a particular field of work. In this case it is the determination of geometrical arrangements of atoms in crystals and in molecules. Diffraction, most conveniently of x-rays and electrons, is the only general method for doing this. Spectroscopic methods are applicable to gases of simple molecular structure and while they are very useful they will not further concern us.

Before discussing a few points connected with this particular award I should like to acknowledge my indebtedness to a number of people. An adequately equipped laboratory for diffraction work with x-rays and electrons represents considerable investment and requires constant mechanical service and improvement. Splendid facilities in this respect have been made available in the Fertilizer Division of the Bureau of Chemistry and Soils. Dr. Knight and Dr. Kunsman as directors have not been insistent that all of the work be of an applied nature and by this attitude they have permitted me and my associates to stay abreast with rapidly advancing fields. It has been my good fortune to be associated with Dr. Maxwell, Mr. Mosley and Mr. Jefferson in this work. Some of the work closely connected with this award was carried out with Dr. Deming who has always been ready with mathematical advice. It has also been my pleasure to have had stimulating contacts with the personnel of many other organizations in Washington, especially with the Geophysical Laboratory, the National Museum, and the Geological Survey in work on minerals.

When waves fall upon a repeated network a diffraction pattern is obtained and some knowledge of the network can be gained from study of positions and intensities of the interference maxima in this pattern. Crystals are formed by regular repetition of units containing a small number of atoms and x-rays having wavelengths of the order of magnitude of the interatomic distances are available. These are the ideal conditions underlying studies of crystal structures.

The geometry of a crystal diffraction pattern and the absence of certain maxima immediately give the dimensions and symmetry of the small unit, the repetition of which builds up the macroscopic

[1] Address delivered before the Chemical Society of Washington on March 10, 1938 on the occasion of the award of the Hillebrand Prize for 1937. Received March 25, 1938.

crystal. This usually contains only a small number of molecules, or of atoms if molecules are not present as in ionic substances, and it can be determined for any crystal. The symmetry of this unit and the number of molecules that it contains immediately gives some knowledge of the minimum molecular symmetry. In this way we find that oxalic acid in its two anhydrous crystalline forms and in its hydrate has a center of symmetry, that is all the oxygen atoms and probably the carbon atoms are in one plane. Similarly it is found that the oxalate ion in the sodium, potassium, and rubidium acid salts and in the potassium and rubidium normal salts does not necessarily have an element of symmetry. In ammonium oxalate monohydrate it has at least a two-fold axis which, too, does not require a plane group. The question is one of possible rotation about a bond that organic chemists consider to be single.

Structure analysis goes further and from intensities of the diffraction maxima attempts to find positions of all atoms in the small unit. In principle this can be done for any crystal but in practice it is impossibly difficult for many. One not only has to find atomic positions within the molecules but simultaneously find the relationship of the molecules to each other. Only the former of these is of much interest to the chemist.

Any assistance external to the diffraction itself for simplifying the structure analysis is permissible since in the end a correct structure can be checked with absolute accuracy. The simplest assumption is that of chemical composition, a more complex one is of approximate molecular shapes and sizes. Molecules have properties that vary with direction and the amount of this variation can often be estimated from knowledge of simpler compounds and structural formulas. Some of these properties are magnetic susceptibility, optical polarization, absorption spectra, and optical activity. If they are not modified too seriously by the proximity of other molecules they can be used to gain some knowledge of molecular orientation in the crystal.

In order to test the use of optical polarization complete structure determinations were carried out for a number of oxalates and their indices of refraction and optic orientations were measured. It was found that the oxalate ion was closely planar in many oxalates and that the orientation of the ion could accurately be determined from the crystal optics. This showed that interaction between the molecules did not strongly affect their polarizabilities, which was the question at issue. Mr. Jefferson and I further demonstrated this by showing that the mean molecular refractivity of highly anisotropic

molecules is approximately the same in crystals where they have definite orientations and in their melts where positions are random.

At the present time crystal structure workers are chiefly engaged in the study of those molecular compounds that have some simplifying property such as a plane benzene ring of known shape and size, or a compound having an approximately plane group of atoms with the planes of the groups parallel in its crystals. Knowledge of refractive indices for a number of such compounds permits choice of those whose structure might be determined most easily and speeds a determination on its way.

The objective in the study of the oxalates was to determine the relationship between crystal structure and crystal optics. However, it also involved us in some questions about the structures of the oxalate and carboxyl groups. Robertson[2] carried out a careful analysis of the structure of oxalic acid dihydrate, which has a plane group. He found that the carbon to carbon distance is 1.43Å which is much shorter than 1.54Å as generally found between carbon atoms joined with a single bond. It is in fact somewhat closer to 1.34Å, the characteristic double bond distance. According to theories developed chiefly by Pauling[3] and his associates, this would indicate contribution of several possible structures to the stable state of the group, that is resonance, one of which involves a double bond. Robertson indicated that a partial double bond character not only accounted for the small distance but also for the plane group.

Mr. Jefferson and I carried out an equally careful analysis of the structure of ammonium oxalate monohydrate. The separation of the carbon atoms in the oxalate ion of this salt proved to be 1.58Å which is not significantly greater than 1.54Å, the usual single bond distance. Moreover, the ion is not planar but the two $-CO_2^-$ ends are turned 28° with respect to one another. This last fact even more strongly than the first rules out the possibility of resonance involving a partial double bond character. Such a result is not unexpected since the acid and its ion are two entirely different groups. In the acid, too, the connection through hydrogen with other groups in the system must profoundly affect the group itself.

The two oxygen atoms of a carboxyl part of an oxalate ion are sensibly alike in their atomic separations and this is in entire harmony with the resonance theory. Carbon oxygen bond distances, moreover,

[2] ROBERTSON. J. Chem. Soc. 1936: 1817.
[3] PAULING et al. J. Am. Chem. Soc. 57: 2705. 1935.

are smaller than expected single bond values. Pauling,[4] however, has shown that a carboxylic acid, partially, and its ester, entirely, have normal carbonyl oxygen atoms. There is, therefore, less expected resonance in oxalic acid hydrate than in its salts.

A correct explanation for the shortened carbon to carbon distance in oxalic acid dihydrate is probably to be found in the work of Penney and Kynch.[5] They have shown that a single bond distance is shortened by the proximity of a double or triple bond in the case of dibenzyl, stilbene, and tolane. Thus it would appear that conjugation of the carbonyl groups in oxalic acid is really responsible for the shortened carbon to carbon distances, the plane group, and the unusual chemical properties.

I have discussed these subjects since they were in part the object of this particular award. They illustrate to some extent the type of problems studied by x-ray diffraction. There is no magic in any of this work and the confusing detail of a particular paper should never obscure the firm basis of physical theory behind it and the exactness of the final answer.

[4] GILMAN, H. "Organic Chemistry," Vol. II, p. 1871, New York (1938).
[5] PENNEY and KYNCH. Proc. Roy. Soc. A164: 409. 1938.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

CHEMICAL SOCIETY

498TH MEETING

The 498th meeting was held in the Auditorium of the Cosmos Club on Thursday, February 10, 1938, with President DRAKE in the chair. After the reading of the minutes it was announced that the Hillebrand Prize Award for 1937 was to be presented at the March meeting to STERLING B. HENDRICKS for his work in the field of crystal and molecular structure.

The Society was addressed by J. E. MAYER of the Johns Hopkins University who spoke on *peculiarities in the critical region*. It was pointed out that the long accepted view of the liquid-vapor critical phenomena is subject to reexamination in the light of recent developments both from the standpoint of experiment and of theory. Recently measured values of the densities of the coexisting liquid and vapor do not favor the view that the vapor acquires the same density as the liquid at the temperature at which the meniscus vanishes. This temperature is the point at which the interfacial tension becomes zero. Theoretical arguments speak for the existence of a range of temperature above this point, within which the pressure is not dependent upon the volume, over a limited range of volumes. This paper was discussed by MOREY, BRICKWEDDE, KRACEK and STIMSON.

A colored motion picture entitled "Scientific Tank Farming" was shown through the courtesy of the Plant Culture League of San Pedro, Calif., and the cooperation of F. G. COTTRELL.

499TH MEETING

The 499th meeting was held in the Auditorium of the Cosmos Club on Thursday, March 10, 1938, President DRAKE presiding. The meeting was held in conjunction with the annual dinner of the Society.

The Past President, B. H. NICOLET, reviewed the history and the significance of the Hillebrand Prize. President DRAKE then presented the 1937 Award to STERLING B. HENDRICKS for his contributions on the *relation of crystal optics to crystal structure* and on the *determination of molecular structures by X-ray and electron diffraction*. The recipient responded with an address which is published in this number of the JOURNAL (p. 247). Professor EDWARD TELLER of the George Washington University then gave an address of which the following is an abstract:

EDWARD TELLER: *Crystals illuminated by waves and waves illuminated by crystals.* The interaction of waves and crystals, which is the main field of Dr. Hendricks' work, presents a double interest. For the physicist it opens up the possibility of studying the nature of waves; and to the chemist it gives a tool to inquire into the molecular structure of crystals. Thus the interaction of *light* and crystals attracted the attention of Huyghens whose discovery of double refraction seemed to contradict his wave theory of light. (In those early days waves meant longitudinal waves.) In the meantime the idea of transversal light waves and Maxwell's theory not only explained Huyghens' experiments, but it made it also possible to study molecular polarizabilities and molecular form. For instance, Dr. Hendricks determined with the tool of double refraction the orientation of oxalate molecules and nitrate ions in crystals. In the case of nitrates he found the interesting phenomenon of free rotation. The accuracy of our knowledge of crystals was greatly increased by the *X-ray diffraction* discovered by v. Laue. Questions such as the one about the ionic nature of the alkali halides became settled and whole new territories such as the chemistry of silicates were disclosed. Dr. Hendricks participated in this work by his investigation of kaolins. *The electron-diffraction* demonstrated by Davisson and Germer had a revolutionary effect on physics. It made possible the understanding of the physical laws in the inside of atoms and all but abolished the boundary between physics and chemistry. In direct chemical research electron beams proved useful for investigating molecules in the gaseous state. The reason for this is that the electrons are scattered much more strongly than X-rays; therefore, on the one hand, they cannot penetrate easily into the interior of crystals but, on the other hand, they give sufficiently strong scattering in gases. Drs. Hendricks and Maxwell used these properties to determine interatomic distances in alkali halides and in the S_2 molecule. They also investigated the interesting structures of molecules like As_4, P_4, P_4O_6 and P_4O_{10}. It is hoped that these experiments will be continued. Thus the *diffraction of neutrons* (which problem has been already attacked by various investigators) promises to be of great interest in nuclear physics and may make it possible for the chemist to learn the position of a particle which has eluded both X-ray and electron bombardment, namely, the position of the hydrogen atom. There are great difficulties to be overcome. The present neutron sources are weak, and since no absorber exists which stops neutrons of all velocities, a great amount of background neutrons are present. Further complications may be caused by inelastic collisions with the crystal-lattice. But the use of focusing methods and rough mosaic crystals, as well as strongly cooled neutrons, may make these experiments (which Dr. Hendricks is planning) successful in the near future.

500TH MEETING

The 500th meeting was held in the Auditorium of the Cosmos Club on Thursday, April 14, 1938, with President DRAKE in the chair. The meeting was preceded by a buffet supper which was also served in the Auditorium.

The Secretary read the minutes of the 1st, 50th, 100th, 200th, 300th and 400th meetings of the Society, partly because they represented milestones in the Society's existence, and partly because of the points of special interest contained in them. President P. E. HOWE of the Washington Academy of Sciences then read a memorial from the Academy, felicitating the Chemical Society on this historic occasion.

The Society was addressed by C. A. BROWNE who read a paper on *Doctor Thomas Antisell and his associates in the founding of the Chemical Society of Washington*, which is published in this issue of the JOURNAL (p. 213). The paper was illustrated by early photographs of groups of chemists and of chemical laboratories, as they existed in the Department of Agriculture and in the Geological Survey in the period between 1870 and 1890 approximately. These were of very great historical interest, and were received with enthusiasm by the Society. Particularly valuable were the photographs of ANTISELL, F. W. CLARKE, H. W. WILEY, and their associates.

The 500th meeting was then adjourned, and after a period of darkness, the 1000th meeting was opened. Peculiarly, in a way, from our present point of view, President DRAKE still occupied the chair. This he explained, recalling the 500th meeting, was the result of the great progress made in the biochemical sciences, which made it possible to arrest the normal aging processes. J. F. COUCH, also well preserved, then read the minutes of the 999th meeting, which was devoted to the great advances made in the new science of Farm Chemurgy, creating great surpluses of power alcohol, and to the very ingenious ways of dealing with this problem. Madjur A. Shirt (B. H. NICOLET) reported on the photopolymer method of making practically indestructible clothing for the masses. This paper was discussed by H. C. FULLER, who in his present capacity of a shade, having lived too early to avail himself of the benefits of present scientific advances, was somewhat handicapped in making the audience see the points he raised. General Always Ponder (L. W. BUTZ) discussed a paper of great importance on the social aspects of his discoveries of *atheletone* and *esthetone*, two vital agents in the problem of proper division of labor between the male and the female sex. The meeting was concluded by a report on the remains of famous chemists whose bodies had been willed to science, by Dr. M. Wrench (S. B. HENDRICKS), who explained the results in the light of the new *keyhole theory of proteins*.

FRANK C. KRACEK, *Secretary*